TITLE

METHOD AND APPARATUS FOR SUPPORTING

ERROR CAUSE OF SNMP

CLAIM OF PRIORITY

[0001]   This application makes reference to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C. §119 from an application entitled *METHOD FOR SUPPORTING ERROR CAUSE OF SNMP AND APPARATUS THEREOF* earlier filed in the Korean Intellectual Property Office on 14 February 2003 and thereby duly assigned Serial No. 2003-9518.

BACKGROUND OF INVENTION

Field of the Invention

[0002]   The present invention generally relates to a method and an apparatus for exchanging an error message between an SNMP manager and an SNMP agent using SNMP (Simple Network Management Protocol) V1/V2/V3 protocol. More particularly, the present invention relates to a method and an apparatus for supporting error cause of SNMP, capable of exchanging error cause defined based on different standards between the manager and the agent, when it is impossible to express a present error status using the error cause defined by the SNMP standard.

Description of Related Art

[0003]   In recent years, most network-related equipments including the Internet have been using

1   a network management protocol based on an SNMP (Simple Network Management Protocol), to

2   manage network and monitor operations of respective network devices. The SNMP is the most

3   typical network management protocol, and through which, an SNMP manager and an SNMP agent

4   can exchange data.

5   [0004]   There are only 20 error cause messages defined by the SNMP standard. If the manager

6   makes a request to the agent, the agent gives a response when the request is normal. However, if the

7   request is abnormal or if a corresponding command cannot be executed, it is very difficult to express

8   an error status more accurately.

9   [0005]   In other words, the certain set of error cause messages are the only ones the SNMP

10   standard of the related art provides. Therefore, if a present error cause is not listed in the 20 error

11   messages defined by the SNMP standard, it is very difficult to express the present error status.

12   [0006]   In such case, the manager cannot receive a more accurate error cause message from the

13   agent, and performs a next operation based on an inaccurate error cause message, only causing a

14   second, third unexpected errors.

SUMMARY OF THE INVENTION

16   [0007]   An object of the invention is to solve at least the above problems and/or disadvantages and

17   to provide at least the advantages described hereinafter.

18   [0008]   Accordingly, one object of the present invention is to solve the foregoing problems by

19   providing a method and an apparatus for supporting error cause of SNMP, wherein a manager

20   transmits a request message to an agent, and if it is impossible for the agent to execute the message

1   normally, the agent provides a more accurate error cause from more extended standard error cause

2   messages, thereby facilitating network management.

3   [0009]   It is another object of the present invention to be advantageously used for preventing error

4   occurrence for the second, third time due to ambiguous error causes, by expressing a status of an

5   SNMP agent more accurately than 20 error causes defined by SNMP V1/V2/V3, where in this

6   manner, when an operator does network management, a great amount of time is saved.

7   [0010]   It is yet another object to provide the use of error cause categories of a different standard,

8   it is possible to integrate different error causes by project, applying to the development of an SNMP

9   agent for other equipment later on, and it can be a new standard for defining a SNMP error cause.

10   [0011]   It is still another object to provide an apparatus for supporting error cause of SNMP that

11   is more efficient, easier to implement, and more cost effective.

12   [0012]   The foregoing and other objects and advantages are realized by providing a method for

13   supporting error cause of network management system configured by an SNMP (Simple Network

14   Management Protocol) manager and a SNMP agent, the method including: if an error which is not

15   defined in SNMP error causes is occurred, selecting a standard error cause management interface to

16   be used; numbering an error cause defined by the selected interface; storing the numbered error cause

17   in a database of the SNMP manger database and a database of the SNMP agent, respectively; and

18   when standard error cause is databased, actually exchanging a message between the SNMP manager

19   and the SNMP agent, and conducting a network management operation.

20   [0013]   Preferably, the step for exchanging the message between the SNMP manager and the

21   SNMP agent and conducting the network management operation includes: receiving, at the SNMP

1   agent, an SNMP message from the SNMP manager under Get/SetRequest command; comparing and

2   deciding, at the SNMP agent, whether a normal operation on the SNMP message is possible by

3   analyzing the received SNMP message; if the normal operation can be performed, executing, at the

4   SNMP agent, an internal command, and transmitting a response message thereof to the SNMP

5   manager; if the SNMP message is abnormal, comparing and deciding, at the SNMP agent, whether

6   the SNMP message can be represented by a SNMP standard error cause; if the SNMP message can

7   be represented by the SNMP standard error cause, transmitting, at the SNMP agent, the SNMP

8   manager a response message defined by the SNMP standard error causes; and if the SNMP message

9   cannot be represented by the SNMP standard error cause, transmitting, at the SNMP agent, the

10   SNMP manager a response message based on a different error cause.

11   **[0014]**   Another aspect of the present invention provides an apparatus for supporting error cause

12   of network management system configured of an SNMP (Simple Network Management Protocol)

13   manager and a SNMP agent, the apparatus including: a SNMP manager mounted with a database

14   for providing SNMP standard error causes and a database for providing extended standard error

15   causes besides the SNMP standard error causes by using a different protocol, and an error analysis

16   application for analyzing an extended standard error cause; and an SNMP agent mounted with a

17   database for providing SNMP standard error causes and a database for providing extended standard

18   error causes besides the SNMP standard error causes by using a different protocol, and an error

19   search application for searching an error cause number in case an error cause corresponding to a

20   present error status is found in the extended standard error causes, and recording the error cause

21   number in an Err-Status field of a SNMP PDU (Protocol Data Unit).

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]   A more complete appreciation of the invention, and many of the attendant advantage

thereof, will be readily apparent as the same becomes better understood by reference to the following

detailed description when considered in conjunction with the accompanying drawings in which like

reference symbols indicate the same or similar components, wherein:

[0016]   FIG. 1 is a diagram depicting a message exchange of an SNMP (Simple Network

Management Protocol) according to the present invention;

[0017]   FIG. 2 is a diagram illustrating a SNMP message format according to the present invention;

[0018]   FIG. 3 is a flow chart describing a message transmitting and receiving in a network

management system to which an SNMP of the related art is applied;

[0019]   FIG. 4 is a flow chart describing a method for supporting error cause of network

management system using SNMP according to a preferred embodiment of the present invention;

[0020]   FIG. 5 shows an example of a computer including a computer-readable medium having

computer-executable instructions for performing a technique of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0021]   Turning now to the drawings, FIG. 1 is a diagram depicting a message exchange of an

SNMP according to the present invention, and FIG. 2 is a diagram illustrating an SNMP message

format according to the present invention, and FIG. 3 is a flow chart describing a message

transmitting and receiving in a network management system to which an SNMP of the related art is

1   applied.

2   **[0022]**   Referring to FIGs. 1 through 3, when an SNMP manager 10 transmits a request to an

3   SNMP agent 20, the SNMP agent 20 receives the request message (S10), and compares/decides

4   whether or not the received message can be executed normally (S20). If the SNMP agent 20 can

5   respond to the request, the SNMP agent 20 transmits a corresponding response to the SNMP

6   manager 10 (S40).

7   **[0023]**   On the other hand, if the request message turns out to be an abnormal message in step 20,

8   the SNMP agent 20 transmits the SNMP managers 10 the response as SNMP V1/V2/V3 standard

9   error cause (S30).

10   **[0024]**   As illustrated in FIG. 2, the standard error cause is numbered in an Err-Status field in an

11   SNMP PDU (Protocol Data Unit).

12   **[0025]**   More details on SNMP messages transmitted and received to/from the SNMP manager 10

13   and the SNMP agent 20 are now explained.

14   **[0026]**   The following are commands that are transmitted and received to/from the SNMP manager

15   10 and the SNMP agent 20 shown in FIG. 1.

16   **[0027]**   - GetRequest: A request signal for reading an object

17   **[0028]**   - GetNextRequest: A request signal for reading a next object after a present object

18   **[0029]**   - GetResponse: A response signal for a request

19   **[0030]**   - SetRequest: A signal for writing an object value

20   **[0031]**   - Trap: Exceptional status information

21   **[0032]**   Each field in the SNMP message format shown in FIG. 2 is now explained.

1   **[0033]**   - LLC/MAC field: Logical Link Control/Media Access Control address

2   **[0034]**   - IP field: IP (Internet Protocol) address

3   **[0035]**   - UDP (User Datagram Protocol): A port number being used

4   **[0036]**   - version: SNMP version

5   **[0037]**   - Community: Particulars in password system defined between a manager and an agent

6   **[0038]**   - Type: Kind of a message (e.g. '0' is GetRequest.)

7   **[0039]**   - Req-ID: This is set up by a manager, and an agent returns an equivalent value to

8   GetResponse.

9   **[0040]**   - Err-Status: '0' denotes a normal status, and other numbers besides '0' denote error

10   causes.

11   **[0041]**   - Variable Bindings: Diverse bindings for variables (object ID)

12   **[0042]**   Among others, the Err-Status (error status) will be explained in more detail.

13   **[0043]**   Standard error cause messages defined in SNMP V1/V2/V3 standard are illustrated in

14   Table 1.

15   **[0044]**   [Table 1]

Error status	Variable
#define NO_ERROR	0
#define TOO_BIG	1
#define NO_SUCH_NAME	2
#define BAD_VALUE	3
#define READ_ONLY	4

#define GEN_ERR	5
#define NO_ACCESS	6
#define WRONG_TYPE	7
#define WRONG_LENGTH	8
#define WRONG_ENCODING	9
#define WRONG_VALUE	10
#define NO_CREATION	11
#define INCONSISTENT_VALUE	12
#define RESOURCE_UNVAILABLE	13
#define COMMIT_FAILED	14
#define UNDO_FAILED	15
#define AUTHORIZATION_ERROR	16
#define NOT_WRITABLE	17
#define INCONSISTENT_NAME	18
#define LAST_ERROR	19

[0045] As shown above, there are 20 kinds of error cause messages defined by the SNMP standard. If the manager makes a request to the agent, the agent gives a response when the request is normal. However, if the request is abnormal or if a corresponding command cannot be executed, it is very difficult to express an error status more accurately.

[0046] In other words, the above error cause messages in Table 1 are only ones that the SNMP standard of the related art provides. Therefore, if a present error cause is not listed in the Table 1, it is very difficult to express the present error status.

1   **[0047]**   In such case, the manager cannot receive a more accurate error cause message from the

2   agent, and performs a next operation based on an inaccurate error cause message, only causing a

3   second, third unexpected errors.

4   **[0048]**   Reference will now be made in detail to exemplary embodiments of the present invention,

5   which are illustrated in the accompanying drawings.

6   **[0049]**   To begin with, TL1 error cause (Transaction Language 1) is explained.

7   **[0050]**   TL1 is an equipment maintenance/management protocol defined by an American company,

8   BELLCORE (currently, TELECORDIA), back in the early 1980's. It is a message transfer system

9   between OS (Operations System) and NE (Network Element) being formatted on the basis on MML

10   (Man-Machine Language) of ITU-T (International Telecommunication Union - Telecommunication)

11   Z.3XX series.

12   **[0051]**   TL1 defines commands for maintenance/management of communication equipments and

13   networks constructed with communication equipments, response messages thereof, rules for

14   composing those commands and response messages and the like. In fact, TL1 is the most popular

15   command for maintenance/management of communication equipment/network not only in the North

16   America but also in the rest of the world. Well-known enterprises using TL1 command line

17   language include ALCATEL, NORTEL, LUCENT, FUJITSU, CIENA, CISCO, NEC and so on.

18   **[0052]**   TL1 has the following benefits.

19   **[0053]**   1. TL1 is very easy to understand.

20   **[0054]**   Unlike SNMP, which is a Machine-to-Machine Management Protocol, and CMIP

1   (Common Management Information Protocol), TL1 consists of commands and messages in ASCII

2   (American Standard Code for Information Interchange) character string. Since SNMP and CMIP

3   uses Binary encoded format, called ASN.1 (Abstract Syntax Notation #.1), an ordinary person cannot

4   read it and even when he/she does, there is no way to understand its meaning. TL1, on the other

5   hand, uses ASCII characters, so anyone can read and understand messages without specific

6   knowledge in TL1 grammar.

7   **[0055]**   2. It is possible and easy to mechanically create and interpret commands and messages. .

8   **[0056]**   Each command and each message are architecturally structured in block units. Since

9   function and grammar are accurately defined for each block, it is easy to mechanically create and

10   interpret messages. Also, TL1 is easily converted to a binary format for use in Machine-to-Machine

11   communications.

12   **[0057]**   3. Management of automatic report and operational commands is possible.

13   **[0058]**   All automatic report messages, commands, and response messages include a TAG field

14   for management. In case of automatic report messages, an automatic tracking function can be

15   implemented by using an ATAG (Automously correlation TAG), a sequentially increasing counter,

16   which is divided according to kinds of messages (*e.g.* failure, performance). In case of operational

17   commands, a CTAG (Correlation TAG) is used to provide correlation between commands and

18   response messages.

[0059]   4. Almost every operational command and message is defined.

[0060]   Operational commands and messages with different functions (failure, configuration, performance, security *etc.*) are defined for every possible case. Moreover, parameters and error codes are fully detailed as well. Therefore, when TL1 is applied, a same message can be used for a same function, regardless of kind of equipment, that is, equipment compatibility is provided.

[0061]   As such, TL1 error cause is easy to use for an operator. In addition, since TL1 defines every error case, if there is any undefined error in SNMP V1/V2/V3, it is informed to a manager via TL1, and the manager is then able to figure out what causes an error more accurately, performing a more accurate analysis and error process.

[0062]   In general, TL1 error causes are categorized (large categories) as follows.

[0063]   Each category is divided into sub-error causes (small categories), and each of the small categories was numbered at 200 intervals.

[0064]   - Error objects in relation to equipment ready status are illustrated in Table 2 below.

[0065]   [Table 2]

Error causes	Descriptions
TL1_EATN=100	Equipage, Not Valid for Access Type
TL1_ENAC=200	Equipage, Not equipped with Alarm Cutoff
...	...
TL1_ENSS=3200	Equipage, Not equipped with Synchronization Switching

[0066]   - Error objects in relation to input are illustrated in Table 3 below.

[0067]   [Table 3]

Error causes	Descriptions
TL1_ICNV=3400	Input, Command Not Valid
TL1_IDNV=3600	Input, Data Not Valid
...	...
TL1_ISPC=5800	Input, Syntax invalid PunCtuation

[0068]   The same numbering system with 200 intervals is applied to error objects in relation to

privilege, status, resource, and fault, so no details on this will be provided.

[0069]   As discussed above, when adding sub-error causes (small categories) given that the

sub-error causes are already numbered at 200 intervals, a corresponding object is searched out from

the error cause objects (large categories), and a new number is given to the corresponding object (for

example, if it is related to 'Input, Command Not Valid', choose one of 3401 to 3599).

[0070]   Supporting error cause of a network management system configured by an SNMP (Simple

Network Management Protocol) manager and a SNMP agent can be further clarified by the

following. There is a selection of a standard error cause management interface to be used, if an error

which is not defined by SNMP error cause occurs. Then, there is a numbering of an error cause ·

defined by the selected interface. The numbered error cause is stored in a database of the SNMP

manager database and a database of the SNMP agent, respectively. When the standard error cause

1 is databased, there is actually an exchanging of a message between the SNMP manager and the

2 SNMP agent, and conducting a network management operation.

3 **[0071]** The TL1 (Transanction Language 1) can be used for the standard error cause interface

4 selected. The error causes can be numbered by categorizing the kinds of error and sub-categorizing

5 already categorized objects additionally, and error objects created when a new error occurs are newly

6 added to corresponding categories. The kinds of error causes may be numbered at 200 intervals. The

7 standard error cause stored in the databases can be interpreted based on an error status corresponding

8 to a number given by an error analysis application that is installed in the SNMP agent and the SNMP

9 manager. The standard error cause stored in the databases can be represented by a number in an

10 Err-Status (error status) field of SNMP PDU (Protocol Data Unit), in accordance with the kind of

11 error.

12 **[0072]** Explained now is a method for supporting error cause in network management system that

13 provides error causes by applying TL1.

14 **[0073]** FIG. 4 is a flow chart describing the method for supporting error cause of network

15 management system using SNMP according to a preferred embodiment of the present invention.

16 **[0074]** Referring to FIG. 4, the SNMP agent 20 receives an SNMP message from the SNMP

17 manager 10 under Get/SetRequest command (S100), and analyzes the received SNMP message to

18 compare and find out whether or not a normal execution is possible (S200).

19 **[0075]** If it turns out that the normal execution is possible in step 200, the SNMP agent 20

20 executes an internal command, and transmits a response message thereof to the SNMP manager 10

1 (S300).

2 **[0076]** However, if it turns out that the SNMP message is abnormal in step 200, the SNMP agent

3 20 compares current error status (SNMP message) to error cause stored in a database about SNMP

4 standard error causes. And SNMP agent 20 finds out whether the error status can be represented by

5 one of the error causes stored in the database about SNMP standard error causes (S400).

6 **[0077]** If the SNMP message can be represented by the error cause stored in the database about

7 SNMP standard error causes in step 400, the response message based on the SNMP standard error

8 causes is transmitted to the SNMP manager 10 (S410).

9 **[0078]** On the other hand, if it is impossible to express by the error cause stored in the database

10 about SNMP standard error causes in step 400, the SNMP agent 20 transmits the response message

11 using different standard error causes (TL1) stored in a database about different standard error causes

12 (TL1) (S420).

13 **[0079]** The present invention can be realized as computer-executable instructions in

14 computer-readable media. The computer-readable media includes all possible kinds of media in

15 which computer-readable data is stored or included or can include any type of data that can be read

16 by a computer or a processing unit. The computer-readable media include for example and not

17 limited to storing media, such as magnetic storing media (*e.g.*, ROMs, floppy disks, hard disk, and

18 the like), optical reading media (*e.g.*, CD-ROMs (compact disc-read-only memory), DVDs (digital

19 versatile discs), re-writable versions of the optical discs, and the like), hybrid magnetic optical disks,

20 organic disks, system memory (read-only memory, random access memory), non-volatile memory

21 such as flash memory or any other volatile or non-volatile memory, other semiconductor media,

1   electronic media, electromagnetic media, infrared, and other communication media such as carrier

2   waves (*e.g.*, transmission via the Internet or another computer). Communication media generally

3   embodies computer-readable instructions, data structures, program modules or other data in a

4   modulated signal such as the carrier waves or other transportable mechanism including any

5   information delivery media. Computer-readable media such as communication media may include

6   wireless media such as radio frequency, infrared microwaves, and wired media such as a wired

7   network. Also, the computer-readable media can store and execute computer-readable codes that

8   are distributed in computers connected via a network. The computer readable medium also includes

9   cooperating or interconnected computer readable media that are in the processing system or are

10   distributed among multiple processing systems that may be local or remote to the processing system.

11   The present invention can include the computer-readable medium having stored thereon a data

12   structure including a plurality of fields containing data representing the techniques of the present

13   invention.

14   [0080]   An example of a computer, but not limited to this example of the computer, that can read

15   computer readable media that includes computer-executable instructions of the present invention

16   is shown in FIG. 5. The computer 500 includes a processor 502 that controls the computer 500. The

17   processor 502 uses the system memory 504 and a computer readable memory device 506 that

18   includes certain computer readable recording media. A system bus connects the processor 502 to

19   a network interface 508, modem 512 or other interface that accommodates a connection to another

20   computer or network such as the Internet. The system bus may also include an input and output

21   interface 510 that accommodates connection to a variety of other devices.

1 **[0081]** In conclusion, the present invention can be advantageously used for preventing error

2 occurrence for the second, third time due to ambiguous error causes, by expressing a status of an

3 SNMP agent more accurately than 20 error causes defined by SNMP V1/V2/V3. In this manner,

4 when an operator does network management, a great amount of time is saved.

5 **[0082]** Moreover, using error cause categories of a different standard (namely, TL1), it is possible

6 to integrate different error causes by project, applying to the development of an SNMP agent for

7 other equipment later on, and it can be a new standard for defining an SNMP error cause from now

8 on.

9 **[0083]** While the present invention has been particularly shown and described with reference to

10 exemplary embodiments thereof, it will be understood by those skilled in the art that the foregoing

11 and other changes in form and details may be made therein without departing from the spirit and

12 scope of the invention.